Rabbit neutering in primary care education: insights from a surgical clinic

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Abstract

Involvement in canine and feline surgical neutering clinics is generally considered to be a key element of primary care veterinary education, yet opportunities for veterinary students to develop their surgical skills with rabbit patients are uncommon. This is despite the fact that Rabbits are currently estimated to be the 3rd most popular companion animal species and the British Small Animal Veterinary Association (BSAVA) recommends that all non-breeding rabbits should be neutered soon after they attain sexual maturity. We describe a pilot rabbit neutering clinic designed to provide high quality care for rabbit patients whilst offering opportunities for undergraduate surgical and case management skills development. We report on the clinical outcomes for patients. Rates of morbidity (n=18) and mortality (n=1) were low. Of complications reported, the majority (n=16) were considered minor. Challenges included ensuring staff and student training in the specific features of rabbit anaesthesia and recovery behaviour. We conclude that rabbit surgical clinics offer excellent learning opportunities for undergraduate veterinary students; and that with prior training in handling and close individual supervision it is possible to achieve good clinical outcomes and to have a positive impact on the welfare of companion animal populations.

Key words: Primary-care-education, pilot-rabbit-neutering-clinic, undergraduate-veterinary-students, morbidity, mortality, surgical skills, neutering, orchiectomy, ovariohysterectomy.

Introduction

Developing competency in surgical skills is a key focus in undergraduate veterinary education; with statements of surgical skills outcomes included in a number of professional competency frameworks [1,2]. In many modern veterinary curricular, opportunities for students to develop their skills in simulated environments in earlier parts of veterinary curricular have been successful in preparing students for performing surgical procedures under supervision in real patients during the later parts of the programme [3–7]. Although the ability to gain experience of surgery in live animals is often considered vital for appreciation of the intricacies of issue handling and surgical decision making [3,8]; provision of adequate surgical opportunities in real patients represents a real challenge for veterinary educators [8,9]. The requirement for "direct and continuous supervision" of students by a qualified veterinary surgeon [10] and the increased time taken by novice surgeons to perform procedures makes these surgical opportunities resource intensive to provide. Veterinary students may have high expectations of the number of surgical procedures that they will have completed at graduation and perceived levels of surgical competency in ovariohysterectomy are a common source of anxiety in both senior students and new graduates [9,11].

Traditionally, surgical skills development in the small animal species have focused on canine and feline neutering reflecting the frequency with which these procedures are performed in general practice. Many programmes have developed links with canine and feline shelters or local primary care practices to assist in offering these opportunities [3,12,13]. However, the number of procedures completed by individual students varies both between and within programmes [3,9] and canine ovariohysterectomy procedure is considered to be surgically challenging [9,14–16] and may not be the best introduction to surgical procedures for less experienced students.

A rabbit-focused undergraduate surgical skills development opportunity has to our knowledge, never been reported in the veterinary literature. Rabbits, as companion animals, are the third most popular pet in United Kingdom, with an estimated number of 1.2 million [17]. They are also considered as popular pets in many other parts of the world [18]. The British Small Animal Veterinary Association (BSAVA) recommends that all non-breeding rabbits should be neutered soon after they attain sexual maturity [19]. However, in many Veterinary programmes, the syllabus is still strongly focused on canine and feline companion animal practice and little of rabbit and exotic medicine and surgery, despite the increases in numbers of these pets [20]. Few programmes have a strong focus on rabbit medicine and surgery and consequently new graduates may feel ill prepared to deal with the needs of these patients when they encounter them in clinical practice[21]. Although didactic lectures in rabbit species are frequent and there are a number of excellent initiatives reported to increase exposure to rabbit medicine and surgery, it is less common to find individual species-based clinical rotations dealing with rabbits as part of senior clinical training. As a result, experience in basic handling, husbandry and clinical care of rabbits may vary widely between students, and is often dependent on engagement with zoological vet and student societies or external veterinary practice placements.

We report on a pilot scheme for a clinic designed to provide neutering for rabbits presented as part of a charitable rehoming project. The aims of the clinic were to provide high quality care and safe surgical neutering, preparing rabbits for rehoming, while providing opportunities for senior veterinary undergraduates to gain experience in rabbit surgery, care and case management.

From a professional and ethical perspective, we considered the first priority in evaluating the clinic to be to establishing that patient safety and welfare were safeguarded. This is particularly important as the involvement of students in a rabbit schemes has not previously been reported in the Veterinary literature and rabbits have traditionally been considered to be challenging patients to anaesthetise safely.

As a consequence, the aims of this evaluation study are:

1. To review clinical data from the pilot study and report on factors relevant to patient safety and animal welfare
2. To share insights from the pilot study and propose areas which could be further developed
3. To contextualise these findings so that other Veterinary educators considering running a rabbit neutering clinic can consider the extent to which our findings may apply to their own context

Students training at the University of Glasgow, School of Veterinary medicine complete a 5 year BVMS (Bachelor of Veterinary Medicine and Surgery) programme. The school is accredited by the Royal College of Veterinary Surgeons, the European Association of Establishments for Veterinary Education and the American Veterinary Medical Association. A number of areas of the curriculum provide training in rabbit medicine and general surgical skills. Students in years 1 & 2 of the programme complete practical sessions in basic surgical skills, (e.g. suturing, ligation, instrument handling) as well as small mammal handling and restraint. Students in years 3 & 4 complete a short lecture course (6 lectures) on rabbit medicine and surgery as well as continued clinical skills training in more advanced surgical techniques (e.g. wound closure, surgical neutering) in simulated settings in the clinical skills laboratory. In the final year of training, although students may complete an elective in exotics and zoo animal medicine, there is limited exposure to small mammal species in the core training, with the majority of cases being seen in the primary care setting as part of the Small animal practice rotation.

In common with other UK veterinary schools, BVMS students are required to complete 38 weeks on extra mural studies (EMS) over the course of their training. This comprises 12 weeks of preclinical EMS with a focus on animal handling and husbandry followed by 26 weeks of clinical EMS, usually spent in a range of veterinary practice settings. Although many students will gain experience working with rabbits during their EMS studies, the level of this experience is variable.

Materials and Methods

This was a 1-year-pilot rabbit clinic taking place at the teaching Small Animal Hospital of the University of Glasgow. The clinic formed part of the core skills in small animal practice rotation of the final year of the BVMS (bachelor of Veterinary medicine and Surgery) Programme. A total of 80 healthy adult rabbits were admitted between June 2013 and July 2014 for elective surgery (Ovariohysterectomy and Orchiectomy). All rabbits belonged to a local rabbit charity that aimed to re-home the neutered animals.

Description of Clinic Protocol
The clinic ran for one day each week, and involved a group of four students in all aspects of the medical and surgical management of two rabbits under the direct supervision of the same clinician. Once the animals had been admitted to the hospital, physical examination was performed to assess the general health of each rabbit. If the animals were considered good surgical candidates, they received bimodal analgesia consisting of either buprenorphine (Buprecare ®, Animalcare Ltd, UK) or butorphanol (Alvegesic ®, Dechra, UK) and meloxicam (Metacam ® Boehringer Ingelheim Ltd UK) and a gastro-protectant such as ranitidine (Zantac ® Rosemont Pharmaceuticals Limited, UK). The rabbits were then premedicated and anaesthesia was induced in a quiet part of the surgical preparation area, away from cats and dogs. General anaesthesia was maintained using isoflurane via endotracheal tube until the rabbit was extubated (recorded as "GA Time"). The anaesthesia was performed and supervised by the Hospital's specialist anaesthetists and the final year students attending the anaesthesia rotation. The surgical procedures were performed by the veterinary students under the direct supervision of the clinician (recorded as "SX Time"). Surgical procedures were performed as described by Harcourt-Brown [22] with small personal variations of the clinician (Table 1 and 2). Once the anaesthetic had been switched off, the animal was monitored until signs of arousal were seen and the endotracheal tube removed (recorded as "RE Time"). Patients were then moved back to the rabbit ward and allowed to fully recover inside an incubator (Brinsea ®). Monitoring continued post operatively until patients were considered to be alert, able to sit in sternal recumbency and able to thermoregulate, with a body temperature above 37.5° C (recorded as "PO time") (Table 3). The rabbits were then moved to their own kennel where hay, food, water and a hiding place were available. Assisted feeding and further medical treatments such as analgesia and gastric protectants were provided. Every 4 hours patients were assessed for demeanour, appetite, faecal output, body temperature, respiratory rate and heart rate. Rabbits were discharged by the clinician the following day, following physical examination to assess the general health of each animal.

Data recording and classification
Medical information was recorded on forms used routinely at the Small Animal Hospital and consisting of Small Animal Hospital Ward form, Anaesthesia Record form, and Recovery from General Anaesthesia form. Mortality and morbidity were recorded for each animal throughout the year. Mortality was defined as any cause of death that would happen while the animal was hospitalised. Morbidity was defined as any complications that would happen during the surgical procedures and during the 24 hours post operatively. Complications were classified as either major or minor.

Data analysis
The data were analysed retrospectively. Descriptive statistics are used to describe the basic features of the data in this study. Continuous variables are expressed as either median (range) or mean (standard deviation (SD)). A general linear model was used for comparison of the two surgical procedures. $P < 0.05$ was considered statistically significant.

Results

Of the 80 animals, 9 animals were excluded from the analysis either because the files were missing (n=5) or because the surgical procedure had not been performed (n=4). The latter was generally due to cancellation of the surgical procedure due to hospital emergencies (n=3) or discovery that the animal had already been neutered (n=1).

Overall, the median (range) age of the rabbits (n=71) was 1.6 years (0.6-5). The median (range) body weight (BW) was 2.4 (0.96 -5.9) kg. The rabbit breeds are described in Table 4. The mean (SD) duration of the GA time was 71.49 (17.56) min and of the SX time was 44 (17.4) min. The mean (SD) RE time was 3.68 (4.57) min and the PO time was 68.67 (31.95) min. One rabbit died during the anaesthesia induction due to cardiac arrest (Mortality, n=1; 1.4%). 18 rabbits developed complications (Morbidity) (25.7%), of which 2 were considered Major (2.8%) and 16 Minor (22.85%) (Table 5). All the complications resolved within 48 hours.

The subset of these rabbits admitted for ovariohysterectomy (OVH) (n=46) had a median (range) age of 1.8 (0.6-5) years and a BW of 2.6 (1.15-5.9) Kg. During this procedure the mean (SD) GA time was 79.2 (14.3) min, SX time was 52.45(14.18) min, RE time was 3.8(4.5) min, and PO time was 71.8 (34.74) min. Mortality rate was 0 while the Morbidity rate was 9 (Minor n=8, Major n=1) (19.5%).

The subset of these rabbits that were admitted for Orchiectomy (n=25) had median (range) age of 1 (0.6-4) year, BW of 1.79 (0.96 -3.8) Kg. During this procedure the mean (SD) GA time was 55.72 (12.35) min, SX time was 25.09 (8.9) min, RE time was 3.19 (4.6) min, and Post op monitoring time was 61.62 (24.07) min. Mortality was 1 while Morbidity was 9 (Minor n=8, Major n=1) (36%).

Between the two surgical procedures (OVH and Orchiectomy) there was a statistical difference in GA time (P=0.000) and SX time (P=0.000) (Table 6) with the ovariohysterectomy taking more time to be completed, but there was not statistical difference in RE time (P=0.55) and PO time (P=0.294).

Discussion

Anaesthesia and surgical time

The differences in anaesthesia and surgical time between the two groups reflect the complexity of the two surgeries: ovariohysterectomy generally requires more time than orchiectomy due to the opening and closing of the abdominal cavity. In this study the surgical time for castration was approximately half the time required for the ovariohysterectomy. This was also found in a previous study in dogs when the two surgeries were compared [23].

In the present study, anaesthesia and surgical times during ovariohysterectomy were comparable to previous studies: the anaesthesia time and surgical time in dogs were respectively 95 (100) and 75 (77) minutes [16] while in cats were an average of 145 and 105 min [14] respectively. Another study that compared flank and midline approach during ovariohysterectomy in cats reported an average surgical time of 43.7 (11) minutes [24], similar to the time needed to perform the surgery in rabbits. The difference amongst these studies in cats could be due to the protocols and the experience of the supervisor. A previous study where rabbits belonging to a rescue centre were spayed by experienced vets also reported a time similar to this present study (44-50 minutes) [25].

In this study the anaesthesia and surgical time during orchiectomy were respectively 55.72 (12.35) and 25.09 (8.9) minutes (Mean and SD). Freeman et al[23] reported a mean anaesthesia time of 98 (26) minutes to perform a dog castration by students. Such difference could be due to several reasons such as size of the animal and protocol. However, this difference could also be due to the experience of the students. In fact, in their study Freeman et al[23] also reported that the anaesthesia was around 29-30 minutes shorter when 2nd and 3rd years, compared to 1st year students, performed the surgery. In our study, the students were all final year students. This suggests that when planning this type of training the student's experience should be taken in consideration in order to reduce the length of the procedure and therefore the risks associated with it. Similarly, the teaching experience and surgical confidence of the supervisor should also be taken in consideration as this can impact on the time required to perform the surgical procedure. When comparing the surgery time with previous studies, in dogs had been reported an average time of 21.9 (11.5) minutes [26] performed by both students and experienced veterinary surgeons while in rabbits it was reported an average time of 17-22 min [25] performed by experience vets.

It seems that the anaesthesia and surgical time for both rabbit ovariohysterectomy and orchiectomy performed by students does not differ greatly from those previously reported either in other companion animals such as cats and dogs within a teaching environment or performed by experienced vets on rabbits.

Morbidity

In this study, we report low levels of perioperative morbidity in our patients. In rabbits perioperative complications are generally gut stasis, haemorrhages, and wound healing [27,28(pp221-231),29(pp138-156)]. During the present study, the morbidities were classified as minor and major depending on the severity of the presentation and the need of extra medical or surgical intervention. If they were self-limiting with no need of intervention, they were classified as minor [26]. All complications reported occurred within the postoperative 24h. Major complications were an overall rate of 2.8% and consisted in one animal suffering intraoperative haemorrhage and one developing a neurological problem (ataxia), post surgically. Both animals were monitored in the hospital's intensive care unit but recovered well and were discharged two days later. A previous study reported a 3.3% rate of major complications [14] including dehiscence of the abdominal wall and laceration of bladder and intestine during ovariohysterectomy in both cats and dogs. These complications were not reported during our study, however they could easily occur during rabbit surgical procedures, where bladder and the large caecum sit very closely to the reproductive tract. Students should be informed and aware of these types of complications and closely monitored while entering the abdominal cavity.

The overall rate of minor complications was 22.85 %. This included a number of conditions such as wound haemorrhage, reduced appetite and prolonged recovery due to post-operative hypothermia. Other studies in companion animals such as cats and dogs report several rates for minor complications such as 9.5% [14], 20.6 % rate [16], and 47% [26]. All these studies also described similar complications with abdominal haemorrhages and infection and dehiscence of the wound being the most common. All rabbits that experienced minor complications recovered well and were discharged the following day as per protocol.

In rabbits, one of the main considerations during anaesthesia and surgery is the possibility that the animal may develop anorexia post operatively [29]. Of the 71 rabbits included in this study, 4 animals exhibited reduced appetite that improved within two days. All 4 cases occurred during July and were considered potentially the result of warm weather [30] rather than of anaesthesia. Reduced appetite can be caused by higher environmental temperatures [31,32], this can be transient while the animal adapts to the new temperature. In the present study, the room temperature of the rabbit ward was considered to be higher than normal due to the warm weather. Although anorexia is frequently listed as a sequel of general anaesthesia in rabbits, our data do not support this – this may partly be due to the fact that these were elective procedures performed on fairly young and generally healthy rabbits. It may also reflect the inclusion of prokinetic and analgesic drugs within the management protocol.

Mortality

In this pilot study, only a single mortality occurred at anaesthesia induction and was due to cardiac arrest. This is in line with reported figures for anaesthetic risk in rabbits – with an overall mortality rate of 1 animal in 72 and of 1 animal in 137 when only healthy rabbits are taken into consideration[33].The fact that the mortality occurred at induction means that it was unrelated of the student surgery and therefore does not alter our conclusion that the student surgery is safe.

Recovery and Post-operative monitoring time

One of the difficulties identified in this study was the challenge in defining the recovery time in rabbits. In companion animals the recovery time is the time necessary for the animal to be extubated and to sit in sternal recumbency [23]. However, these criteria were difficult to apply during this study where the rabbits, once extubated, take longer to moving into sternal recumbency. Instead, we elected to divide the recovery time described by Freeman et al. (2014) into 'recovery' (RE) and 'post-operative monitoring time' (PO). RE was the time necessary to extubate the rabbits while PO included the period where animals were monitored for return of the righting reflex [25], after being extubated, and for return of normal body temperature to ensure that they were able to maintain normothermia once moved back to their kennel from the incubator.

Post-operative hypothermia can be a common occurrence in small mammals, predisposing them to a prolonged recovery and increasing post-operative complications. During this study, patient recovery times were short and animals were extubated quite easily within an average of 3.68 (4.57) minutes. In contrast, the post-operative time instead was, as expected, longer and lasted an average of 68.67 (31.95) minutes. Hedenquist et al[34] reported the time to extubation in rabbits to be dependent on the anaesthetic used: 20 minutes (range: 5-30 min) by intravenous infusion compared with 6.5 minutes (range: 0-15 min) for gas anaesthesia; while time to reach the righting reflex was respectively 62+/-32 and 27+/-22. In another study where a similar anaesthetic protocol to the present study was used, the time to return of the righting reflex was between 9+/- 6 and 32+/-21, depending on the animal gender and drug dosage [25]. Although, the type of protocol greatly influences the post-operative time, the differences between these studies and the present study are considered minimal. We propose that criteria for rabbit recovery should be developed to reflect these different recovery characteristics. This would help both clinicians and students to apply a consistent approach to not only better monitoring the animals but also recording these figures and enable comparison between protocols and contexts to be made.

Educational significance

Although the findings of this study may be of interest to those working in primary care practice, they are likely to be of particular relevance to those involved in clinical and surgical teaching contexts. Teaching students takes time, and both surgical time and recovery time in this study were longer than would be expected in many practice contexts, although interestingly increased surgical time does not necessarily lead to increased recovery time. The increased time taken for a procedure is unsurprising given that students had limited surgical experience and specific practical techniques for rabbit procedures had not been covered before in the programme. This is important when planning logistics of clinical placements, both in terms of rabbit numbers and student group sizes. It is encouraging however, that involvement of students in the surgical and perioperative care of rabbit patients was not associated with substantial mortality and morbidity rates in this study.

We were fortunate that our study was conducted in a referral hospital environment and with high quality facilities and support from a specialist anaesthetic and nursing team. It is possible, therefore, that clinics running in different hospital or clinic environments may differ in their outcomes.

For veterinary schools aiming to improve access to surgical skills development opportunities for their students, rabbit neutering clinics may provide a feasible option and could broaden the variety of surgical experience available to those in the later stages of training.

Further research

Further research should focus on evaluation of the educational impact of involvement in a rabbit clinic, for example through surveying the students participating in similar programmes in order to evaluate the value of the neutering clinic from an educational point of view and to be able to compare it with cat and dog neutering programmes.

It is also important to consider what constitutes the best preparation for students embarking on rabbit neutering clinics and whether the effect of prior training is able to improve patient outcomes and clinic efficiency even further.

Conclusions

Based on the findings of this pilot study on rabbit neutering, we conclude that surgery involving students under supervision with rabbits is generally safe. It provides high quality care using a management protocol which appears to be successful – producing low rates of morbidity (most cases discharged the next day) and equivalent to the surgical clinical teaching of ovariohysterectomy and orchiectomy in other companion animals such as cats and dogs.

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Table 1: Anatomy of the rabbit reproductive tract

Female	The female reproductive tracts includes two ovaries, two fallopian tubes, two uterine horns, two cervixes, a large flaccid vagina, and a vulva. Female rabbits lack of the uterine body (Popesko et al., 1992.)
Male	The male reproductive tracts includes two testicles within the respective scrotal sacs, epydidimis and penis. In rabbits, the inguinal canal is open and the testicles can move freely from the scrotal sacs to the abdomen and viceversa (Popesko et al., 1992).

Table 2 : Description of the surgical procedures performed during the study.

Ovariohysterectomy:

1. An incision of the skin and abdominal fascia is made along the midline between the umbilicus and the pelvis
2. The ovaries are gently exteriorised.
3. The ovarian blood vessels are double clamped and ligated
4. The uterine blood vessels are double clamped and ligated
5. A transfixing ligature is placed just on the cervixes and the uterine horns removed
6 The abdominal fascia is closed using a continuous suture
7. The skin is closed using an intradermal pattern

Orchiectomy (Scrotal approach, semi closed technique):

1. A 1 cm skin incision is made along the midline of the scrotal sacs.
2. The vaginal tunic is incised and the testicle exposed
3. The vaginal tunic is gently separated from the scrotal skin

4. The vas deferens and the blood vessels are clamped within the vaginal tunic and ligated
5. The testicles is then removed
6. The clamp is removed and the blood vessels inspected for bleeding
7. The scrotal skin is apposed and surgical glue applied
8. The procedure is then repeated with the contralateral testicle.

Table 3: Definition of the parameters assessed during this study

Time	Parameter	Definition
GA	General Anaesthesia Time	General anaesthesia was maintained using isoflurane via endotracheal tube from the time the animal was intubated until the surgical procedure was over.
SX	Surgery Time	The surgical procedures were performed by the veterinary students under the direct supervision of the clinician.
RE	Recovery Time	Once the anaesthetic had been switched off, the animal was be monitored until signs of arousal were seen and the endotracheal tube removed
PO	Post Op Monitoring time	The rabbits were monitored post operatively until they were considered to be alert, able to sit in sternal recumbency and able to thermoregulate, with a body temperature above 37.5° C

Table 4: Summary of the breeds of the rabbits admitted for elective surgery

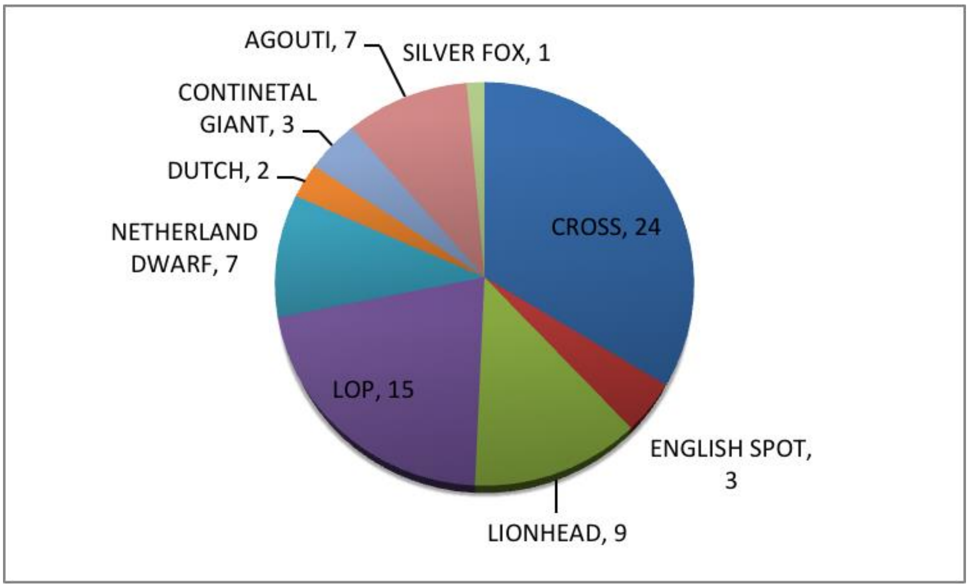
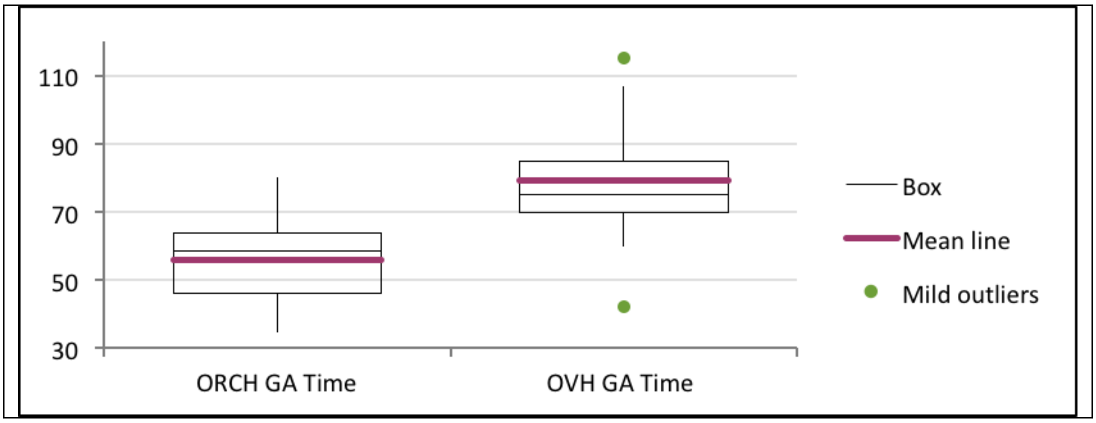
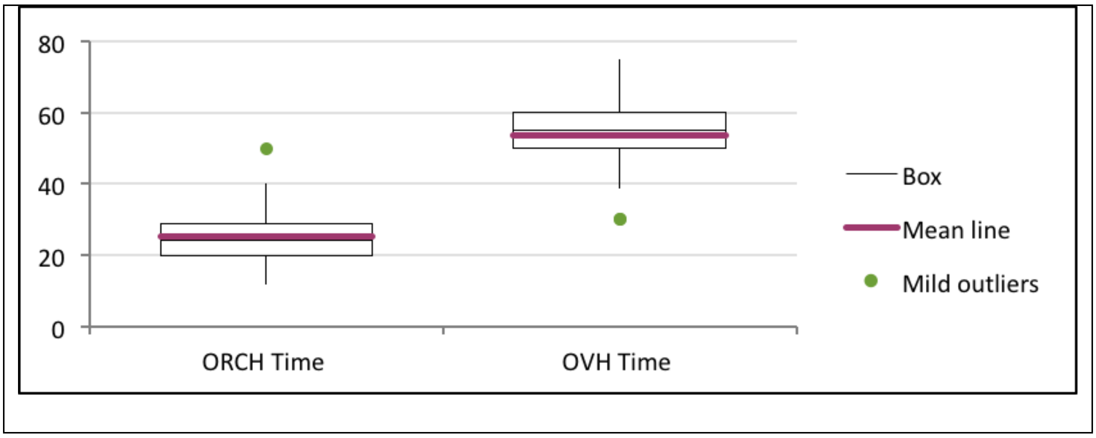


Table 5: List of complications.

	Definition
Major	• Intraoperative haemorrahe (n=1) • Post operative ataxia (n=1)
Minor	• Surgical wound self limiting haemorrhage (n=6) • Reduced appetite (n=4) • Mild post-operative hypothermia (n=4) • Hyperthermia (n=1) • Haematuria (n=1).

Table 6: Boxplot of General Anaesthesia (GA) time and Surgical time (SX) between the two surgeries (ORCH and OVH)




80
60
40
20
0
ORCH Time
OVH Time
Box
Mean line
Mild outliers